



**MOTOROLA INC.**

Communications  
Sector

# 11-1113

## DYNA T•A•C™ CELLULAR MOBILE TELEPHONE INSTALLATION

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## 1. INSTALLATION PLANNING

### 1.1 RADIO SET LOCATION

In most vehicles the best location for the radio unit is the floor of the trunk compartment. Regardless of the location choice, be sure the radio set is protected from dirt and moisture and that there is sufficient space around the radio unit to allow cooling and removal. (Refer to Figure 1.)

### 1.2 CONTROL UNIT LOCATION

When deciding where to mount the control unit, consider the following factors:

- The mounting surface must have sufficient strength to support the control unit.
- The control unit must be within easy reach of the operator during normal operation of the vehicle.

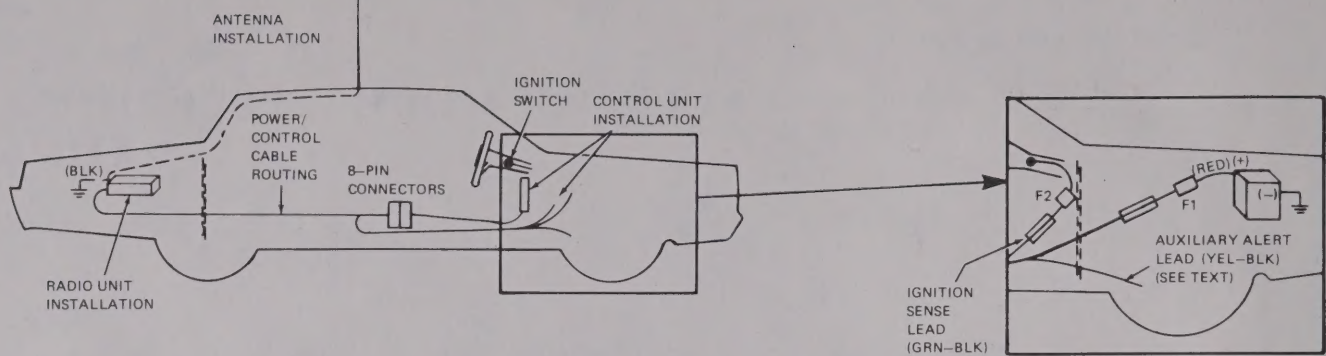
- The control unit must be within reach of the control unit end of the radio unit control cable.

- The proposed location must not interfere with passenger seating or leg space.

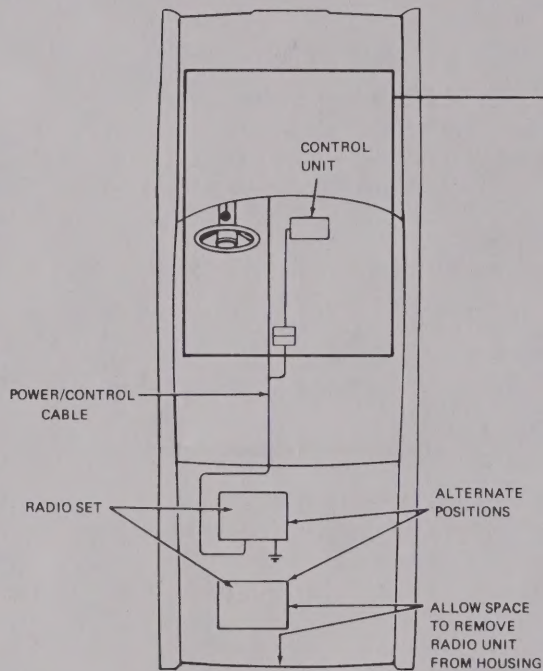
### 1.3 POWER/CONTROL CABLE ROUTING

Many vehicles are equipped with wire troughs in the door sills. If the vehicle has this feature, use it to provide maximum protection for the cables and to simplify installation of the cables. In vehicles without wiring troughs the control and power cables must be routed where they are protected from pinching, sharp edges, and crushing. Use grommets whenever a cable must pass through a hole in a metal panel. One suggested route is along one side of the drive shaft hump under the carpet. However, no matter what method of cable routing is implemented, all in-line connectors must be kept accessible.

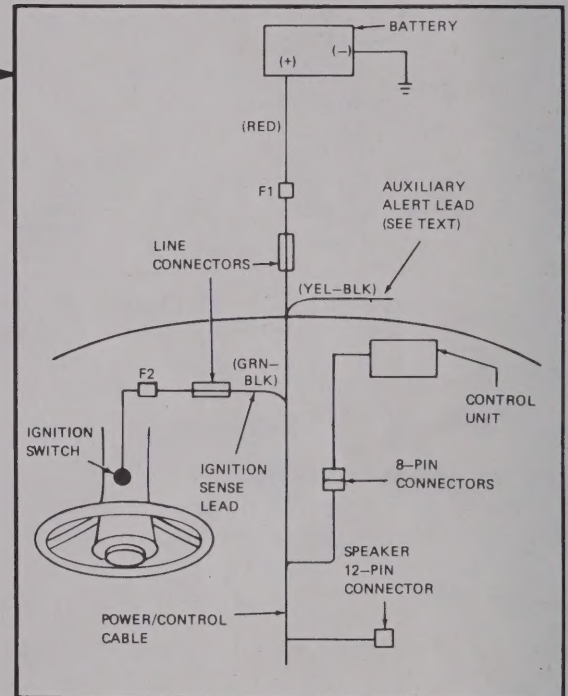




a. INSTALLATION STEPS



b. TYPICAL CABLE ROUTING



GCEPS-39122-B

Figure 1. Typical Mobile Radio Installation

## 1.4 ANTENNA LOCATION

**1.4.1** The best location for the antenna is at the center of the vehicle roof. Be sure that the antenna cable can be acceptably routed to the radio set location before you drill a hole.

**1.4.2** On duplex radios, interference can be produced by non-electrical components. Any two metal pieces rubbing together (e.g., seat springs, shift levers, trunk and hood lids, exhaust pipes, and others) in close proximity of the antenna can cause severe receive interference. Antenna mounting locations should be experimented with (temporary magnet

mount) before any holes are drilled. Make sure that the magnet mount antenna is of the same type as the one that will be actually used (1/4 wavelength, etc.).

## 1.5 ELECTRICAL SYSTEM POLARITY

The mobile telephone system is designed to operate in negative-ground 12-volt electrical systems only.

## 1.6 ELECTRICAL SYSTEM CAPACITY

At 13.6 volts the radio set draws less than 3.25 amps when transmitting. Be sure the vehicle battery and alter-



nator have sufficient current capacity to deliver at least 3.25 amps more than the maximum current that may be demanded by the vehicle and its accessories.

## 1.7 PRIMARY POWER CONNECTIONS

### 1.7.1 Positive Primary Power Lead Connections

**1.7.1.1** The best power connection point for the positive primary power leads is the positive terminal of the vehicle battery. Often, direct connection to the battery is inconvenient and it is easier to connect the positive leads to the starter solenoid. Be sure that the chosen point is always close to the battery.

**1.7.1.2** Many parts of the vehicle can produce electrical noise that interferes with the mobile radio system operation. The ignition system is the most common source of electrical noise interference. During the installation planning stage, be sure to check the condition of the ignition wiring and the connections to the vehicle battery. Also, verify that low resistance connections exist between the battery negative terminal, vehicle chassis, and engine block. All wire connections should be clean and tight.

### 1.7.2 Negative Primary Power Lead Connection

The negative primary power leads must be connected to a good ground point on the vehicle chassis.

## 1.8 NAM PROGRAMMING

**1.8.1** The Number Assignment Module (NAM) is an integrated circuit located in the *DYNA T•A•C* mobile telephone transceiver which stores system control and option information. Prior to operating the mobile telephone, the NAM must be programmed by the installer, technician, or user with the proper data for operation in the particular cellular system.

**1.8.2** With recent up-upgrades in mobile telephone software there are several methods for programming the NAM available. This installation manual only covers NAM programming instructions for mobile telephone equipped with earlier version software (programmable by the Motorola R1801A programmer or equivalent). Table 1 lists all model mobile telephones which use the instructions from this manual. Table 2 lists all model mobile telephones which can be programmed from the control unit using the instructions located in the NAM PROGRAMMING MANUAL 68P81116E77.

### NOTE

After completing a radiotelephone installation, be sure to fill in the Reference Data information in the space provided in the user's manual (usually on the inside back cover). This information includes such items as serial numbers, subscriber telephone number, installation facility, etc.

*Table 1. Sales Model Packages Using Earlier Version Transceiver Software (NAM Programming by Motorola R1801A or Equivalent)*

Series Model	Model Number
<i>DYNA T•A•C 2000</i>	F19CTA8833AA, BA (Motorola) F19CTA8833AG, BG (Private label)
<i>DYNA T•A•C 2000X</i>	F19CTA8832AA (Motorola) F19CTA8832AG (Private label)
<i>DYNA T•A•C 4000</i>	F19CTA8828AA (Motorola) F19CTA8828AG (Private label)
<i>DYNA T•A•C 6000</i>	F19CTA8831AA (Motorola) F19CTA8831AG (Private label)
<i>DYNA T•A•C 6000X</i>	F19CTA8830A (Motorola) F19CTA8830AG (Private label)

*Table 2. Sales Model Packages Using Later Version Transceiver Software (NAM Programming by Motorola R1801A or Control Unit; See instruction manual 68P81116E77)*

Series Models	Model Number
Special Edition <i>DYNA T•A•C 4000</i>	F19CTA8838AG (Private label) F19CTA8828BA (Motorola) F19CTA8828AG (Private label)
<i>DYNA T•A•C 4500L</i> <i>DYNA T•A•C 4500XL</i>	F19CTA8834AA (Motorola) F19CTA8840AA (Motorola)
<i>DYNA T•A•C 6000</i>	F19CTA8831BA (Motorola) F19CTA8831BG (Private label)
<i>DYNA T•A•C 6000X</i> <i>DYNA T•A•C 6000XL</i>	F19CTA8830BA (Motorola) F19CTA8830AG (Private label) F19CTA8839AA (Motorola)

## 2. INTERFERENCE CRITERIA

### 2.1 POSSIBLE INTERFERENCE WITH ANTI-SKID BRAKING SYSTEMS

#### 2.1.1 General

**2.1.1.1** Performance of electronically controlled brake and/or guidance systems can, under certain unique conditions, be subject to interference by mobile radio operation. Although the radio meets or exceeds all requirements regarding rf emissions, the rf power emitted from the antenna cannot be eliminated without adversely affecting operation of the radio.

**2.1.1.2** All electronic automotive control systems have to meet stringent EMI specifications; but a defective control system might have gone undetected until it is required to operate in proximity to a transmitting antenna.

**2.1.1.3** The following recommended transmitter installation and test procedures are suggested for vehicles with electronic anti-skid braking systems.



### 2.1.2 Installation Suggestions

Locate the braking modulator box in the vehicle. A service manual may be helpful to aid in the location of the braking modulator box. Perform transmitter installation in accordance with the following recommended procedure:

- If the braking modulator box is mounted on the right side of the vehicle, mount the transmitter on the left side of the trunk to give it as much space as possible between the braking modulator box and the transmitter. If the braking modulator box is mounted on the left side, reverse the procedure.
- The antenna should be mounted on the opposite side of the car trunk from the braking modulator box.
- Route all cables along the center or on the opposite side of the vehicle from the braking modulator box.
- *Do not* operate the transmitter while the vehicle is in motion with the trunk lid open.

### 2.1.3 Test Procedure

A detailed procedure to check that radio operations does not interfere with brake or guidance systems is provided in paragraph 4.2 of this section. If the vehicle is equipped with such a system, *it is imperative that this procedure be performed before operating the radio.*

## 2.2 POSSIBLE VEHICULAR INTERFERENCE WITH RADIO OPERATION

**2.2.1** Many parts of a vehicle can produce electrical noise that interferes with mobile radio system operation. The ignition system is the most common source of interfering electrical noise. During the installation planning it is a good idea to check the condition of the ignition wiring and the connections to the vehicle battery. Be sure low resistance connections exist between the battery negative terminal, vehicle chassis and engine block. All wire connections should be clean and tight.

**2.2.2** On duplex radios, interference can be produced by non-electrical components as well. Any two metal pieces rubbing together (seat springs, shift levers, trunk and hood lids, exhaust pipes, etc.) in close proximity of the antenna can cause severe receive interference. Antenna mounting locations should be experimented with (temporary magnet mount) before holes are drilled.

## 3. INSTALLATION

### 3.1 RADIO UNIT INSTALLATION

#### 3.1.1 Horizontal Mounting

Refer to Figure 2. If the surface at the proposed mounting locations is uneven, use a number of the large washers, provided in the radio installation kit, as spacers so

that the mounting tray clears all obstructions and is not deformed when installed. Use the radio mounting tray as a template to determine the mounting screw locations. For secure horizontal mounting, three or four of the available mounting screw locations may be used (A, B, C, and D, or A, B, and E in Figure 2). Be sure the tray is mounted in a location that provides adequate cooling for the radio, as discussed in the Installation Planning paragraph. Refer to the following procedure for installing the radio unit:

Step 1. Place the mounting tray on the mounting surface with necessary spacer washers in place. Mark the locations of the mounting screws.

Step 2. Center punch the screw locations. Drill holes for the mounting screws.

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#### WARNING

BE CAREFUL TO AVOID DRILLING INTO THE FUEL TANK OR OTHER VITAL PART OF THE VEHICLE.

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Step 3. With the spacer washers in place under the mounting tray, secure the tray to the mounting surface, using the self-tapping screws and lockwashers.

Step 4. Insert a key into the key slot on the front of the radio unit and rotate the key to the right. Pivot the handle forward.

Step 5. Slide the radio unit into the mounting tray so the two tabs on the mounting tray engage their respective slots in the radio unit. Slide the radio unit as far back as possible, then lock it into the mounting tray by pushing the handle in.

#### 3.1.2 Vertical Mounting

Refer to Figure 3. If the radio is to be mounted vertically on a thin metal wall (e.g., the back wall of a pickup truck), an additional metal reinforcing plate may be required to prevent damage to the wall. (The metal reinforcing plate is not provided with the radio.) Preferably, this plate should be mounted next to the outside wall — although it may be used next to the inside wall. The large metal washers supplied with the TRN9172A Installation Hardware Kit must be used on the outside wall for securing the nuts. Use four bolts, lockwashers, and nuts (not provided).

Step 1. Place the mounting tray on the mounting surface. Mark the locations of the mounting screws.

Step 2. Center punch the screw locations. Drill holes for the mounting screws.

Step 3. With the support washers (and reinforcing plate, if required) in place, secure the tray to the mounting surface, using four bolts, lockwashers, and nuts.



NOTES:

1. THE FOLLOWING ARE PROVIDED:  
(A) FOUR NO. M6.3 X 25 MOUNTING SCREWS (MOTOROLA PART NO. 3-139661)  
(B) FOUR M6.3 LOCKWASHERS (MOTOROLA PART NO. 4-119331).
2. IT IS RECOMMENDED THAT THE FOUR SCREWS BE USED AND MOUNTED AT LOCATIONS A, B, C, AND D. IF, FOR ANY REASON, THREE POINT MOUNTING IS USED, THEN THESE SCREWS SHOULD BE MOUNTED AT LOCATIONS A, B, AND E.

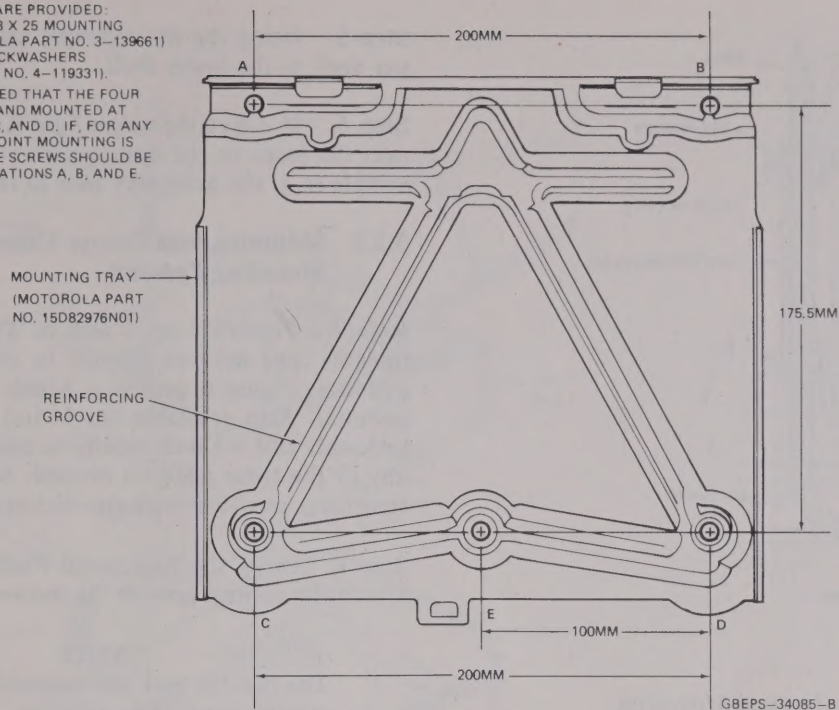


Figure 2. Mounting Tray (Horizontal Mounting)

Table 3. Control Unit Mounting Requirements and Options

Mounting Types & Options	Control Unit Models				4500XL	6000 6000X	6000XL
	2000 2000X	Special Edition	4000 <sup>3</sup>	4500L			
Standard Mounting Cup	Required	Required	Not Available	Required	Required	Required	Required
Angle Bracket	Available	Available	Required <sup>1</sup>	Available	Available		Available
Mounting Pedestal	Available	Available	Required <sup>1</sup>	Available	Available	Available	Available
External Speaker	Available	Required	Not Required	Available	Required <sup>2</sup>	Required <sup>2</sup>	Required <sup>2</sup>
V.S.P. Option <sup>2</sup>	Available	Available	Available	Available	Available	Available	Required

Notes:

1. The DYNA T•A•C 4000 requires either the mounting pedestal or the angle bracket.
2. When the V.S.P. option is provided, the V.S.P. speaker replaces the required external speaker.
3. Before mounting the cradle for the DYNA T•A•C 4000 model, check that V.S.P. sense adjust R60 (accessible from the base of the cradle, see Figure 5) is set for appropriate non-V.S.P. (fully CCW) or V.S.P. (fully CW) operation.

Step 4. Insert a key into the key slot on the front of the radio unit and rotate the key to the right. Pivot the handle forward.

Step 5. Slide the radio unit into the mounting tray so the two tabs on the mounting tray engage their respective slots in the radio unit. Slide the radio unit as



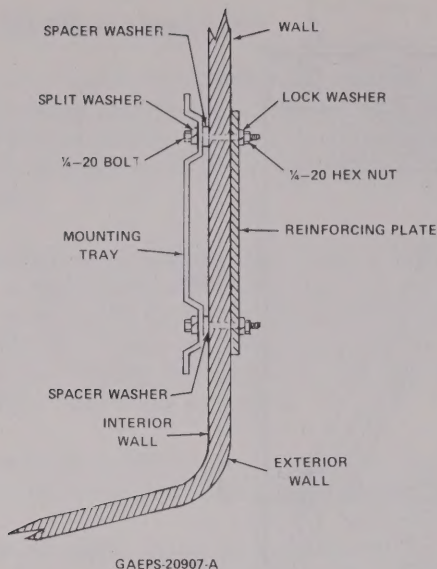


Figure 3. Vertical Mounting

far back as possible, then lock it into the mounting tray by pushing the handle in.

### 3.2 CONTROL UNIT MOUNTING

Depending on the model, the control unit either hangs in a standard mounting cup (Figure 4) or is mounted (Figure 5). The standard mounting cup may be mounted by itself or using either the deluxe universal mounting pedestal (Figure 6) or the adjustable angle bracket (Figure 7). The mounted control unit must be installed using the pedestal or bracket. Table 3 describes installation requirements and accessory availability for the various models.

#### 3.2.1 Standard Mounting Cup by Itself

Step 1. (Refer to Figure 4.) Ensure that the selected mounting surface is sufficiently strong to support the mounting hardware.

Step 2. Using the lower shell as stencil, mark the location of the four outer holes; then drill four 4.1mm (5/32") holes.

Step 3. Using the M5 tapping screws, mount the lower shell.

Step 4. Place the upper shell on top of the lower shell, making sure that the target light leads (Figure 4) are properly routed to the outside, via the small apertures provided in the lower shell or between the two shells of the mounting cup. This should be the case only if the target light will be used; otherwise, the leads should be coiled and left inside the mounting cup shells.

Step 5. Using the M4 machine screws, secure the upper shell to the lower shell.

Step 6. If use of the target light is contemplated, connect the leads to the appropriate voltage source in the vehicle (e.g. the accessory fuse in the fuse block).

#### 3.2.2 Mounting with Deluxe Universal Mounting Pedestal

Refer to Figures 4 or 5 and 6. The control unit (or hangup cup) mounts directly to the deluxe mounting pedestal. Figure 6 depicts a 3-inch flat base mounting pedestal. Also available are 3- and 6-inch angled base pedestals and a 3-inch extension that may be used with any of the three pedestal models. Refer to separate instructions provided with the pedestal for details.

Step 1. Using the four small Phillips head screws (1) attach the control unit to the mounting bracket (2).

#### NOTE

The bracket and ball assembly may be removed from the socket to facilitate attachment of the control unit, if desired. Move the locking arm (8) to the far right (CCW) and unscrew the knurled collar. When reinstalling the control unit to the base, make sure that the locking arm is in the far right position (CCW) before hand tightening the knurled collar.

Step 2. Insert the hex bolt and star washer assembly (3) into a nut driver and attach the ball and socket assembly (4) to the 3-inch base (5) by inserting the bolt up through the base and into the tapped mounting hole. Tighten securely, drawing the ball and socket assembly into the base.

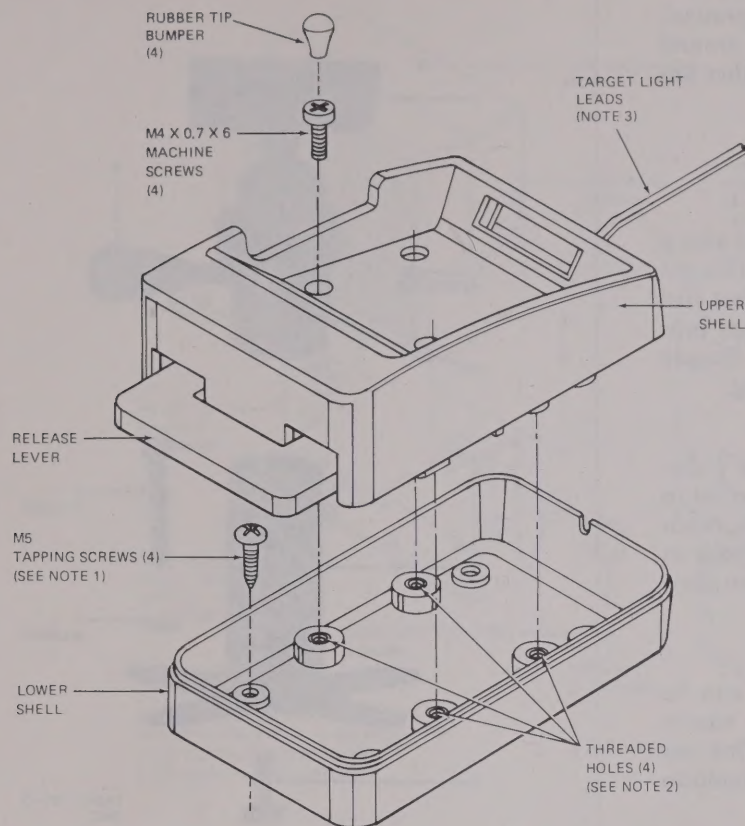
Step 3. Temporarily position the control unit and pedestal to verify the desired mounting location. Check for clearance and operating convenience. Make sure that the pedestal locking arm (8) is positioned as desired. Using the pedestal as a guide, mark four holes on the transmission hump or other selected location. The four mounting tabs on the base are somewhat flexible to conform to a curved surface as necessary.

Step 4. Using an awl or similar device, open four holes in the carpet at the marked locations. This must be done prior to drilling to avoid running the carpet.

Step 5. Using a 4.8mm (3/16") bit, drill the four mounting holes and secure the base using the four 1/4-14 x 1-1/2" tapping screws (6) and four split-lock washers (7).

Step 6. Move the locking arm (8) to the far right side (CCW) of the slot in the ball and socket assembly. This allows the control unit to be turned and tilted to the





#### NOTES:

1. THE FOUR M5 TAPPING SCREWS ARE USED ONLY WHEN LOWER SHELL IS MOUNTED DIRECTLY ON A FLAT SURFACE.
2. THE SECOND SET OF FOUR THREADED HOLES IS USED WHEN LOWER SHELL IS MOUNTED ON THE ADJUSTABLE ANGLE BRACKET.
3. THE TRACER LEAD OF THE TARGET LIGHT LEADS SHOULD BE CONNECTED TO A+ (IF THE TARGET LIGHT IS TO BE USED).

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Figure 4. Standard Mounting Cup Installation

### 3.2.3 Mounting with Adjustable Angle Bracket

Refer to Figures 4 or 5 and 7. Verify that the selected mounting surface is sufficiently strong to support the mounting hardware. The mounting surface does not have to be completely flat since the metal strips (Figure 7) can accommodate mounting surfaces that are slightly curved.

## 3.3 ACCESSORIES AND OPTIONS

### 3.3.1 Speaker Installation

A speaker is required on some models. When *V.S.P.* hands-free operation is implemented, the *V.S.P.* speaker replaces the standard speaker. (Refer to Table 3 for speaker requirements and availability for the particular model.) The speaker should be mounted under the dash, on the transmission hump, or other suitable location using the mounting bracket supplied with the speaker assembly. Figure 8 shows the speaker housing and mounting hardware.

#### NOTE

The speaker housing is electrically insulated from the mounting bracket by insulating washers. It is also important to prevent the speaker housing from contact-

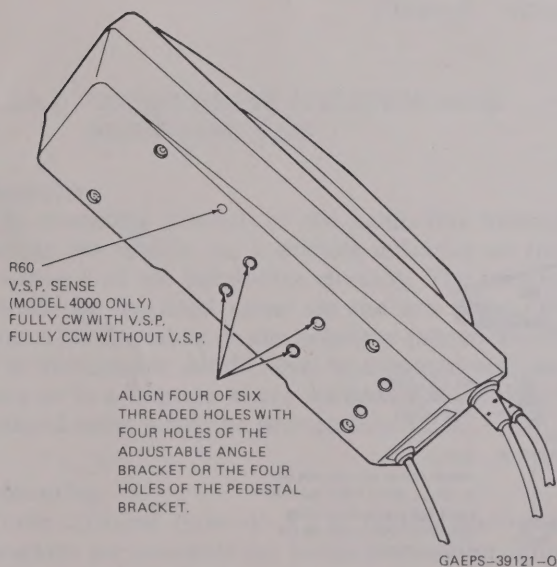


Figure 5. Control Unit Mounting Detail

desired position. Pulling the locking arm toward the center of the slot (CW) will lock the control unit in the desired position.

**NOTE (Cont'd.)**

ing any metal in the vehicle, such as the dashboard or firewall. The speaker housing is connected to ground, and contacting any external metal will cause a ground loop which may introduce alternator whine or other undesirable interference.

### 3.3.2 Auxiliary Alert

**3.3.2.1** Each mobile radiotelephone is provided with a dedicated wire (yellow-black) in the radio power/control cable that grounds the circuit for the first five times the mobile unit rings (provided the user has properly enabled the auxiliary alert feature). This closure has a fixed duration of one second for each ring.

**3.3.2.2** Although the auxiliary alert line has a 1 ampere capacity, it is recommended that the connection to the auxiliary alert device (such as the vehicle horn, headlights, etc.) be made through a suitable relay (such as Motorola Part No. 59K813674) using a 2A slow-blow fuse for circuit protection.

**3.3.2.3** Alternatively, the auxiliary alert line can be connected to a supplemental ringer or light source mounted within the passenger compartment. This can be useful when the vehicle is parked (with the ignition off) in very noisy environments.

### 3.3.3 V.S.P. Hand-Free Operation Microphone

(Refer to Table 3 for applicability of the V.S.P. hands-free option for the particular model mobile radiotelephone.)

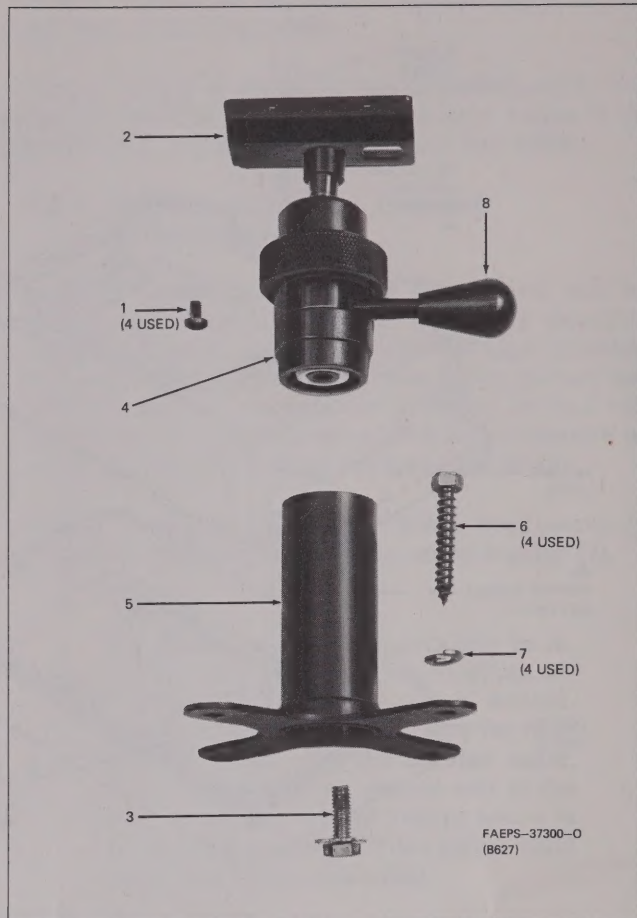


Figure 6. Deluxe Mounting Pedestal

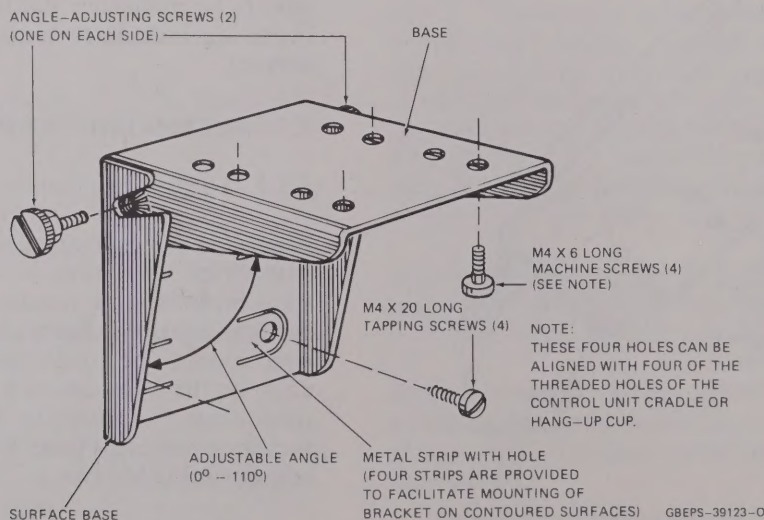


Figure 7. Adjustable Angle Bracket Installation



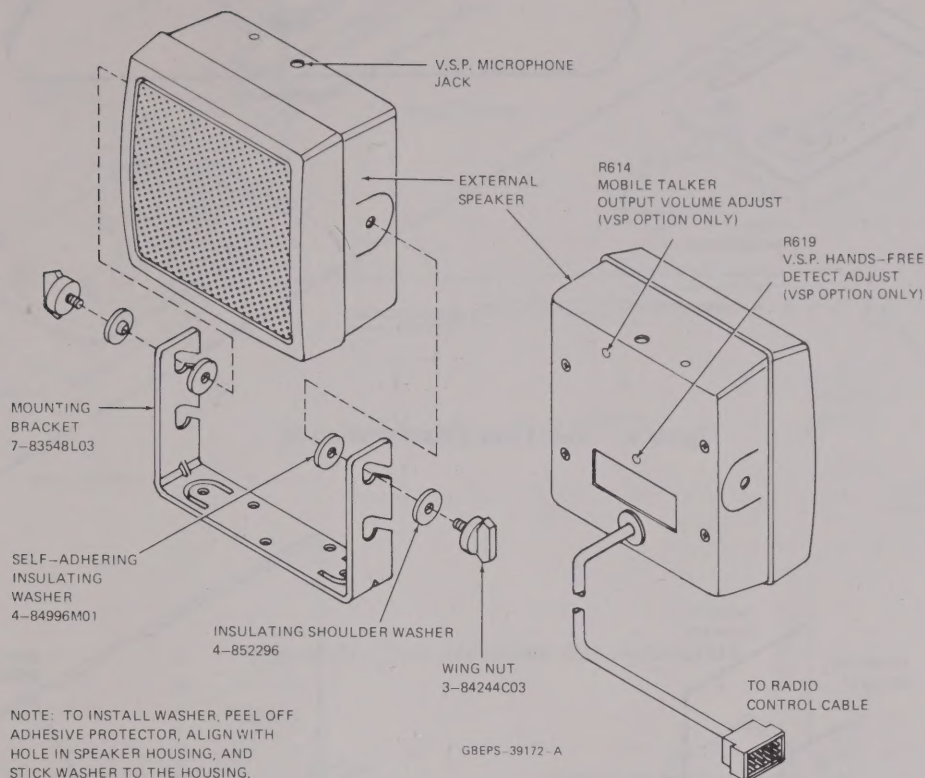


Figure 8. Speaker Mounting Hardware Detail

### 3.3.3.1 MICROPHONE LOCATION AND MOUNTING TIPS

#### Location

The mounting position of the hands-free microphone within the vehicle has a definite influence on the performance of the hands-free circuitry. The microphone should be mounted either on the sun visor (directly above the driver) or on the headliner (above the driver). The microphone should never be mounted near the window or in a location where the road and ambient background noise would be substantially high.

#### Mounting

Three different types of V.S.P. microphone mounting brackets are available for hands-free option. This permits mounting of the hands-free microphone in a variety of ways to meet various mounting considerations that may change from one vehicle to another. Instructions for installing these mounting brackets are given in the following paragraphs. In all installations, the microphone cable should be routed in the most inconspicuous

manner to the speaker box, e.g., behind the windshield pillar trim, behind the kick panels, or some other arrangement. The following paragraphs describe mounting procedures for the three different mounting types.

### 3.3.3.2 VISOR CLIP MOUNTING BRACKET (PROVIDED)

The visor clip mounting bracket (p/o TRN9141A Mounting Kit) provides the simplest and most effective mounting of the hands-free microphone. As shown in Figure 9, the clip slides into channels on the microphone housing, and then clips onto the sun visor. The cable may then be routed, as shown, to the external speaker box.

### 3.3.3.3 SCREW-MOUNTED BRACKET (OPTIONAL)

The screw-mounted bracket (part no. 7-82316N01) may be used if the preferred mounting position (previously explained) is not possible. The bracket is supplied with



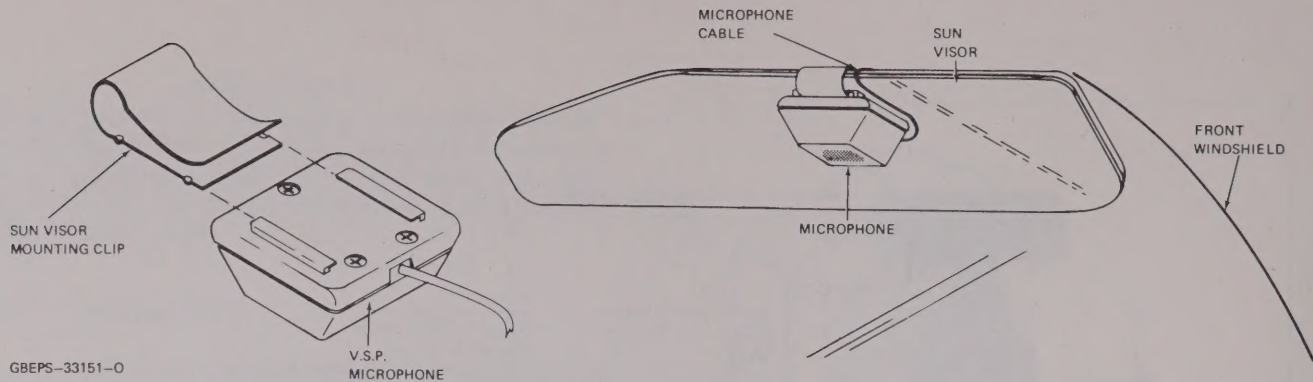


Figure 9. Sun Visor Clip Installation

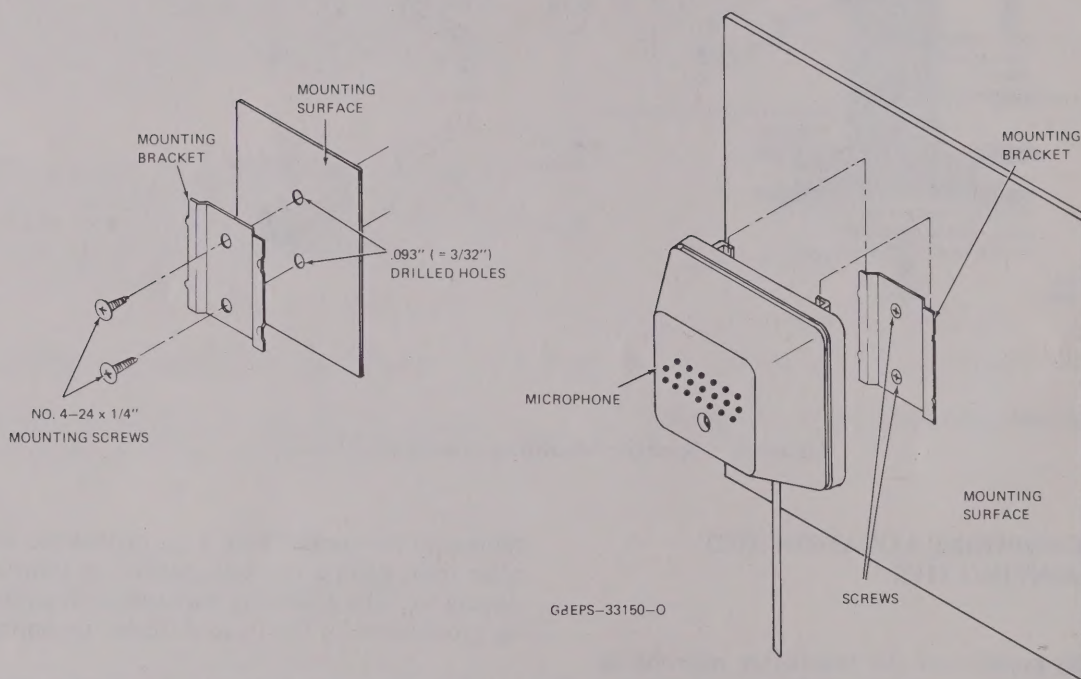


Figure 10. Screw-Mounting Bracket Installation

two (2) mounting screws which secure the bracket to the desired mounting surface, such as the windshield pillar, dashboard, and others. Refer to Figure 10 while performing the following procedure:

Step 1. Select an alternate microphone mounting location. (Consideration should be given to the microphone mounting criteria relating to wind and road noise, to ensure proper V.S.P. operation.)

Step 2. Hold the bracket in the desired location and make sure that there is enough clearance to permit sliding of the microphone.

Step 3. Using the mounting bracket as a template, drill two 2.4mm (3/32") holes.

Step 4. Using the two #4-24  $\times$  1/4 inch screws, secure the bracket to the mounting location. Make sure that the mounting clip rails (extending outward) are away from the mounting surface.

#### NOTE

Before attaching the bracket to the mounting surface, a felt pad or similar item should be placed between the bracket and mounting surface to reduce noise feedback from the surface to the microphone.



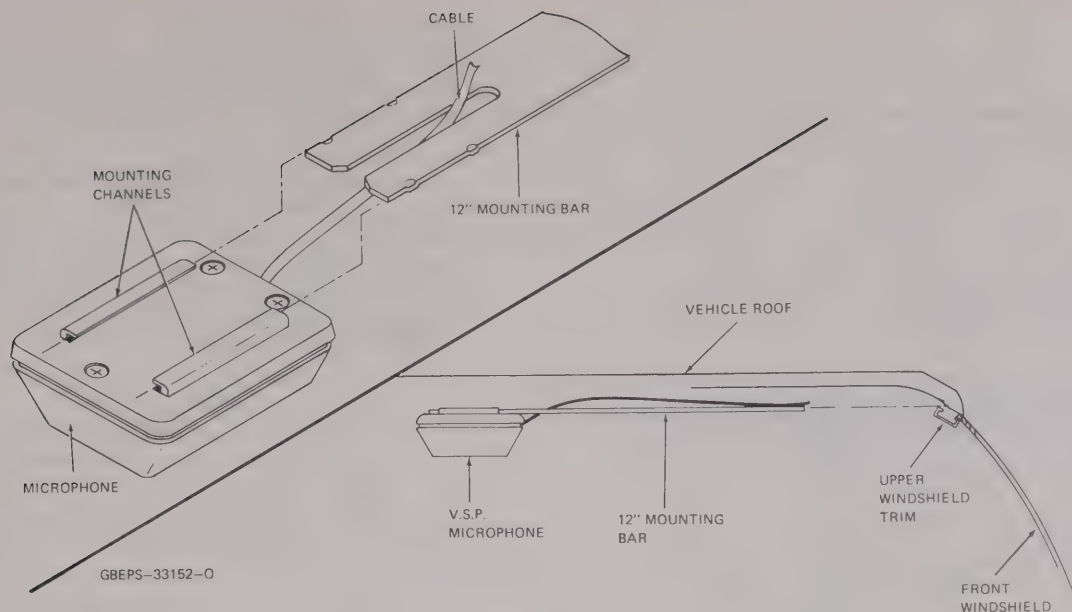


Figure 11. Trim Mounting Bar Installation

Step 5. Slide the microphone onto the clip rails and route the cable to the speaker box.

#### 3.3.3.4 TRIM MOUNTING BAR (OPTIONAL)

The trim mounting bar (part no. 7-82314N01) may be used with installations that do not accommodate either the sun visor or the screw-mounted bracket mounting methods explained in the preceding paragraphs. Refer to Figure 11 while performing the following installation procedure:

Step 1. Loosen the windshield trim, if necessary, and slide the end of the 12-inch bar opposite the slot between the headliner and the windshield trim; the four small bumps along the slot should face downwards. It may be necessary to bend the end of the bar to allow it to slide between the trim and the headliner. This should position the microphone approximately in the same area in which the sun visor would normally be mounted. If this is not the case, the bar may be shortened accordingly.

Step 2. Tighten the windshield trim, if necessary, to secure the bar against the headliner.

Step 3. Route the microphone cable through the slot and slide the microphone onto the bar rails until it locks against the small bumps.

Step 4. Route the cable to the speaker box.

#### NOTE

A felt pad or similar item should be placed between the trim bar (at the microphone) and the vehicle headliner to reduce noise feedback from the vehicle roof.

#### 3.3.3.5 FINAL STEP

After mounting the microphone and routing the cable in an inconspicuous manner, as explained in the preceding paragraphs, connect the microphone cable to the mini-phono connector located in the *V.S.P.* speaker assembly.

### 3.4 INSTALLATION OF CABLES

(Refer to Figure 12)

Step 1. Pull the power/control cables through the trunk partition into the passenger compartment. Run the control unit connector to the approximate location of the control unit. Run the external speaker connector to the approximate location of the external speaker (if equipped).

Step 2. Pull the power cables (2 red #18 AWG A+ supply, 1 green-black ignition sense and 1 yellow-black auxiliary alert) from the external speaker connector cable into the engine compartment. If necessary, cut a hole in the fire wall for the power cables. This hole must have a diameter of 2.5cm (1") to fit the supplied rubber grommet.



#### NOTE

If the ignition sense line (green-black) is to be connected to the vehicle ignition switch, do not pull through. Refer to Table 3.

#### NOTE

If auxiliary alert device is to be used in the passenger compartment, do not pull auxiliary alert line (yellow-black) through.

Step 3. Install and route the antenna coaxial cable, as shown in Figure 1. Refer to the instruction section included with the antenna for details of antenna coax preparation, routing, and installation.

### 3.5 CONNECTING THE CABLES

Step 1. Connect the coaxial cable to the radio and to the antenna. (If the diversity option is implemented there will be 2 coaxial cables and antennas; refer to the instruction section supplied with the diversity supplement for details on the location and connection of these antennas.)

#### NOTE

Remove all fuses and tape them to their respective holders before making any connection. DO NOT insert the fuses until all connections have been made and carefully inspected.

Step 2. Bolt the BLK leads of the power/control cable to the vehicle frame in the trunk compartment.

#### IMPORTANT NOTE

Special attention should be given to locating a good vehicle ground. Optimum radio performance can only be achieved with a ground connection having a very low resistance. The vehicle frame makes the best ground, but body structural reinforcement members are also suitable for grounding purposes. One of the bolts under the mat on the trunk floor may also be used. Thoroughly clean the bolt and the trunk floor if the BLK lead lug is to be bolted to the floor.

Step 3. Connect P5 of the power/control cable to J5 on the radio set.

Step 4. Check the power cable fuses (F1 and F2) and make sure that the correct sizes and types are installed.

Step 5. The fused green-black ignition sense lead (F2, 4A) of the power cable should normally be connected to an accessory A+ terminal at the vehicle fuse block. The

lead may optionally be connected to the battery (+) or left unterminated. Refer to Table 4 and associated notes and then make the desired connection.

#### IMPORTANT NOTE

For proper operation of the convenience on/off feature, the ignition sense lead should be connected to an accessory A+ terminal at the vehicle fuse block.

#### NOTES

1. With the sense lead connected to an accessory terminal you select the convenience mode: (a) the power switch (PWR or ON-OFF) turns the mobile on in the locked mode when the ignition is off, (b) the memory lock status may be changed from unlocked to locked (but not from locked to unlocked) with the ignition off, (c) the mobile power/lock condition is retained in memory when the ignition is turned off, (d) the mobile power/lock status from memory defines the mobile condition when the ignition is turned on, and (e) when the ignition is turned off with the auxiliary alert feature enabled or when the mobile is turned on and unlocked with the ignition off, the mobile will go to the standby mode (*DYNA T•A•C 6000* and *DYNA T•A•C 6000X* only) or will remain on (all other models). The auto-lock feature (*DYNA T•A•C 4000*, *DYNA T•A•C 4500XL*, *DYNA T•A•C 6000*, *DYNA T•A•C 6000X*, *DYNA T•A•C 6000XL* only), when enabled, overrides the memory lock status and the mobile always powers up in the locked condition.
2. With the sense lead unterminated only the power switch (PWR or ON-OFF) is used to turn the mobile on and off. The mobile will always power up in the locked condition and (*DYNA T•A•C 6000*, *DYNA T•A•C 6000X*, and *DYNA T•A•C 6000XL* only) go to the standby mode after it is unlocked.

Step 6. Cut the red wire connected to the supplied F1, 10A fuse holder (to position the fuse in the desired location) and connect one end of the fused RED lead to the positive (ungrounded) battery terminal using the lug supplied with the cable kit. Strip the other end of the fused RED lead approximately 1/2" and insert into one



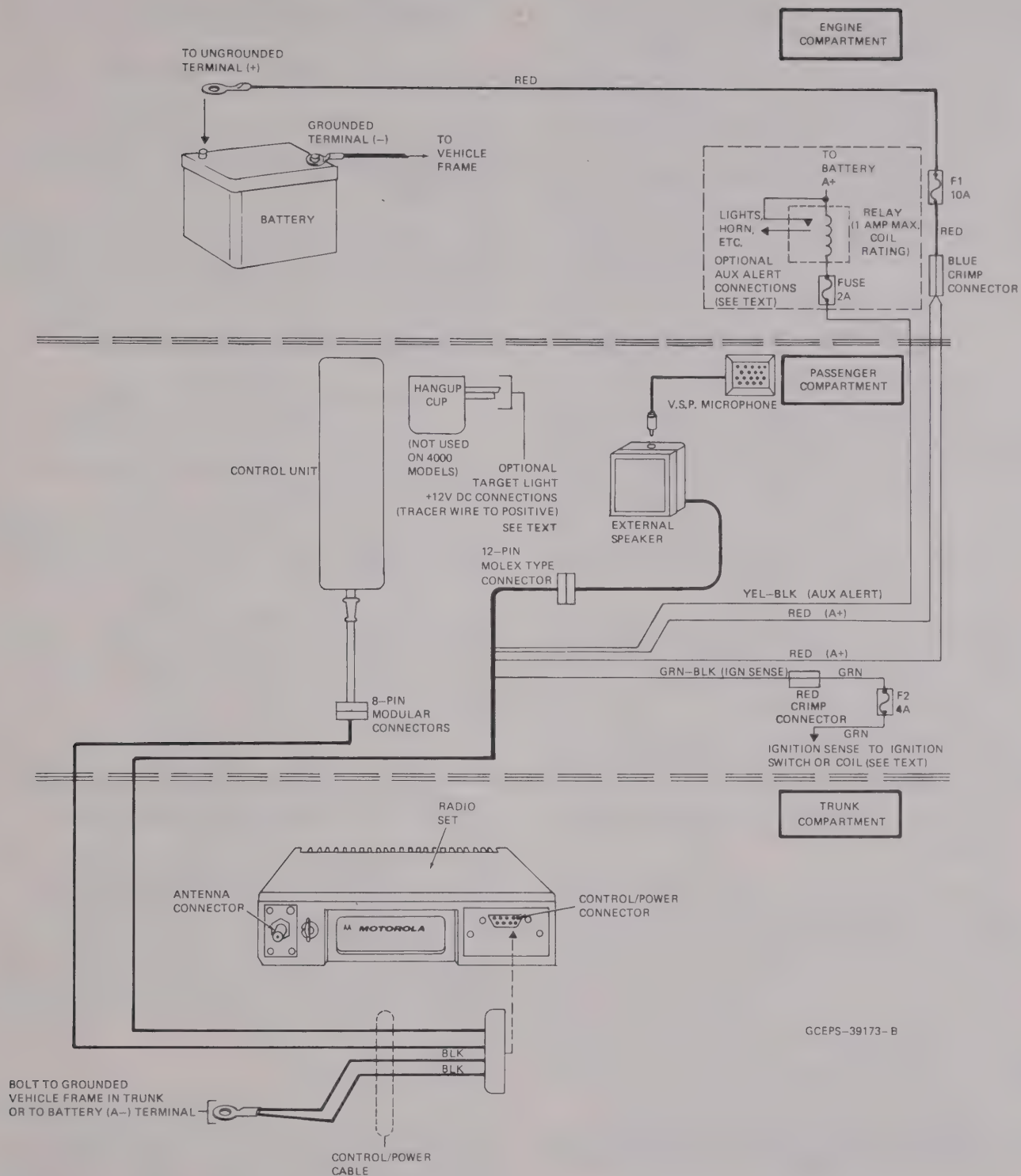


Figure 12. Installation Wiring Details



Table 4. Sense Lead Connections

Sense Lead Connections	Initial Conditions	Action	Result
Ignition	Mobile off, Ignition off	Depress power	Mobile on and locked
	Mobile off, Ignition on	Depress power	Mobile on, lock state from memory (Note 1)
	Mobile on, Ignition off	Depress power	Mobile off (Note 2)
	Mobile on, Ignition on	Depress power	Mobile off
	Mobile off, Ignition off	Ignition on	Mobile on/off and lock states from memory (Notes 1 and 3)
	Mobile off, Ignition on	Ignition off	Mobile off
	Mobile on, Ignition off	Ignition on	Mobile on with existing lock state
	Mobile on, Ignition on	Ignition off	Mobile off (Notes 4 & 5)
Not Connected	Mobile off	Depress power	Mobile on and locked
	Mobile on	Depress power	Mobile off

**NOTES:**

- When the auto-lock feature (*DYNA T•A•C 6000 X* and *6000XL* only) is enabled, the memory lock status is overridden and the mobile will always power up in the locked mode.
- During intervals of operation with the ignition off, the lock status in memory can be changed from unlocked to locked (but not from locked to unlocked). This lock status memory is used when the ignition is turned on with the mobile off. The mobile on/off status in memory will remain unchanged.
- The lock status will be that which is in memory and the mobile condition (on or off) will be the same as it was the last time the ignition was turned off.
- While a call is in progress, mobile power down (or going to standby mode) is delayed after turning the ignition off until the call is terminated.
- When the auxiliary alert feature is provided and enabled, the mobile will go to standby mode (*DYNA T•A•C 6000*, *6000X* and *6000XL*) or will remain on (all other models) when the ignition is turned off.

Step 8. Connect the 12-pin external speaker connector from the cable kit into the connector from the external speaker.

Step 9. Check the power cable A+ connection and verify that the lead is connected to the correct polarity.

Step 10. Pull all excess cabling into the trunk. Using the supplied cable clamps, clamp the cables to the vehicle body or chassis.

Step 11. Carefully inspect all cables and connections. Then insert 10A fuse F1 in the fuseholder on the red

lead and 4A fuse F2 in the fuseholder on the green-black lead (if connected in Step 5).

## 4. PERFORMANCE CHECKS

### 4.1 CHECKING RADIO PERFORMANCE

Once the radio is installed, performance should be checked using the following procedure. Refer to the User's Manual for instructions on turn-on unlock, and keying the radio.

Step 1. Measure the power output of the radio with the radio connected to the vehicle antenna through a directional wattmeter. The voltage standing wave ratio (VSWR) should be less than 2:1. Measure the forward power ( $P_f$ ) and reflected power ( $P_r$ ) with the wattmeter and compute the VSWR as follows:

$$VSWR = \frac{1 + R}{1 - R} \text{ where } R = \sqrt{P_r/P_f}$$

If the VSWR is greater than 2, check the antenna, antenna cable, and connector.

Step 2. Place a call from the mobile and confirm proper operation.

Step 3. Have a call placed to the mobile and confirm proper operation.

### 4.2 CHECKING ANTI-SKID BRAKING SYSTEMS

#### 4.2.1 General

4.2.1.1 Electronically controlled brake and/or guidance systems *should be checked most carefully* and at different speeds for any sign of abnormal operation.

4.2.1.2 Although the radio meets or exceeds all requirements regarding RF emissions, the RF power emitted from the antenna cannot be eliminated without adversely affecting operation of the radio. All electronic automotive control systems have to meet stringent EMI specifications; but a defective control system might have gone undetected until it is required to operate in proximity to a transmitting antenna.

#### 4.2.2 Test Procedure

This test is divided to cover several different types of interference. Disturbance of the electronic anti-skid device can usually be detected in several different ways concerning the vehicle's braking system, i.e., by the lights, any irregular audible sounds, any change in the performance of the braking system itself, etc.

During Checks 1 through 8, however, none of the above conditions should be observed if the radio set is properly installed.



Check 1. With car stationary (gear selector in PARK) and the engine running at a fast idle, key (turn the carrier on and off) the transmitter with and without modulation with your foot off the brake pedal.

Check 2. Repeat the preceding step with your foot on the brake pedal.

Check 3. When making this test, while the car is stationary, allow at least 2 car lengths, and possibly even more, of clear area in front of the vehicle. With your foot on the brake with just enough pressure to keep the vehicle from moving, place the car in a forward gear with the engine at a fast idle, then key the transmitter with and without modulation.

---

#### WARNING

Disruption of the anti-skid braking system may cause the vehicle to move forward in addition to the lights and audible sounds mentioned above.

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Check 4. Driving at a moderate speed (15-25 mph) with your foot off the brake pedal, have an assistant key the transmitter with and without modulation.

Check 5. Repeat Check 4 with your foot slightly on the brake pedal to turn on the brake lights.

Check 6. While making a moderate deceleration stop from 25 to 30 mph, have an assistant key the transmitter with and without modulation.

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#### WARNING

Severe disruption of the electronic anti-skid braking system may cause loss of control of the vehicle during the following test.

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Check 7. While making "panic" stops from 20 mph, have an assistant key the transmitter with and without modulation.

Check 8. If no interference or disruption is noticed, repeat by making "panic" stops from 30 mph.

If no malfunctions are observed after the above tests are performed, it can be assumed no apparent problem exists and the car can be released to the customer.

If any of the above tests results in a brake malfunction, contact the car manufacturer service department as soon as possible and remove the radio from the vehicle. **Do not** complete installation.

### 4.3 AUXILIARY ALERT

- Arrange to receive test calls and enable the auxiliary alert feature using the procedures provided in the user's manual.
- Verify that the alert device is activated from the incoming call and answer the call.
- Have a second call placed with the auxiliary alert feature enabled. Do not answer the call. Verify that after approximately 20 seconds the alert device is deactivated and (for models equipped with a display) that the display indicates CALL after being enabled in the manner described in the user's manual.

### 4.4 V.S.P. HANDS-FREE OPERATION

**4.4.1** After making sure that all control unit and radio cable connectors are properly seated in the appropriate T-connector receptacles, apply power to the radio and place a test call, using the *V.S.P.* operating procedure outlined in the User's Manual. This should be followed by other test calls to verify proper operation of the radio under various conditions.

#### 4.4.2 Receiver Desense

Various forms of receiver desense (duplex, motion, electronic, and sidetone noise) may cause the *V.S.P.* microphone to mute because of noise bursts from the radio receiver. These noise bursts are recognized as land talker audio signals that can cause the *V.S.P.* circuits to mute the *V.S.P.* microphone and turn on the land talker audio switch. Consequently, the mobile operator's speech signals are blocked or chopped. Additional information on detecting and solving desense problems is provided in Motorola Bulletin No. PSD-318A.

#### 4.4.3 Optimization

**4.4.3.1** In a properly operating mobile radio, the *V.S.P.* Hands-Free Operation feature can function without requiring any adjustments to the radio or the *V.S.P.* circuits. However, the following optimization procedures may be used when improper operation of the *V.S.P.* feature occurs.

#### NOTE

Before employing the *V.S.P.* Hands-Free Operation feature, verify that the mobile radio is functioning properly without the *V.S.P.* Hands-Free Operation.

#### 4.4.3.2 OPERATIONAL CHECK

Two potentiometers are provided for the *V.S.P.* board: one (R619) for adjusting the *V.S.P.* detect level at U601, and the other (R614) for adjusting the mobile talker audio output of the board. These two potentiometers are



preadjusted at the factory and do not, normally, require readjustment in the field. However, in certain installations where there is either a high level or an unusually low level of ambient noise, readjustment of both potentiometers may be required. To determine whether or not readjustment of these potentiometers is required, perform the following tests in an area with good signal strength.

Step 1. Place a test telephone call in the *V.S.P.* mode; this requires that the *V.S.P.* unit be completely installed, all windows closed, engine running, and vehicle at rest.

Step 2. Speaking in a normal tone, verify that the unit switches properly from the mobile talker to the land talker. Also, check to determine whether or not the volume heard by the land party is comparable to the volume heard when the mobile user talks into the handset.

Step 3. If the unit does not switch properly or the volume is not correct, adjust potentiometers R619 and/or R614 as explained in paragraph 4.4.3.3 Adjustment.

#### NOTE

Adjustments of R619 and R614 are performed from the back of the *V.S.P.* speaker through adjustment holes. See Figure 8.

#### 4.4.3.3 ADJUSTMENT (IF REQUIRED)

- If switching is incorrect (mobile talker is blocked or chopped), slowly rotate R619 in a clockwise direction until the problem is cleared.
- If switching is incorrect (land talker is blocked or chopped), slowly rotate R619 in a counterclockwise direction until the problem is cleared.
- If the mobile talker volume as heard by the land party is louder in the *V.S.P.* mode than it is in the handset mode, adjust R614 in a counterclockwise direction until the volume in the *V.S.P.* mode is comparable to that in the handset mode.
- If the mobile talker volume as heard by the land party is lower in the *V.S.P.* mode than it is in the handset mode, adjust R614 in a clockwise direction until the volume in the *V.S.P.* mode becomes comparable to that in the handset mode.

## 5. SELF-TEST MODE

### 5.1 INTRODUCTION

**5.1.1** Radiotelephone models using a control unit with a display are equipped for self-test. For models using a control unit that does not include a display, all self-test commands are operative but only those tests that are annotated with (ND) in the **KEYPAD ENTRY** column

serve a useful diagnostic purpose. For models using a control unit that includes only a 7-digit display, the radio status display does not include the first line (channel number and RSSI reading).

**5.1.2** The self test mode may be entered to allow service personnel to control and monitor radio functions via the control unit. This self-test mode operates at two levels: 1) a **status display level**, which allows the mobile telephone to operate as normal while providing status indications on the control unit display; and 2) the **servicing level**, which takes the mobile telephone out of normal service and allows commands to be entered through the handset keypad to control the operation of the radiotelephone.

## 5.2 OPERATING PROCEDURES

### 5.2.1 Status Display Level of Self-Test Mode

**5.2.1.1** This level of operation can be entered by grounding either pin 11 (MAN TEST) on the radio test connector J7 or pin 21 of power/control connector J5 and then powering up the radio. This places the radiotelephone in the status display level of operation. In this mode, the radiotelephone will place and receive calls as normal. However, the handset will display radio status information, such as operating channel, SAT frequency, output power, etc. This display updates once every second. The format and explanation of this status information is given in Table 3 under "02# Radio Status Request".

**5.2.1.2** When dialing a phone number, the display of status information ceases with the first dialed digit. The telephone number is displayed in the normal manner as entered. When the **SND** button (or **END** or **CLR**) is depressed, the status information display resumes.

### 5.2.2 Servicing Level of Self-Test Mode

This level of operation allows the servicing personnel to take control of the radio operation by entering test commands through the handset keypad. Such parameters as operating channel, output power level, muting, and data transmission can all be selected by entering the corresponding commands. The servicing level may be entered from the status display level by depressing the pound (#) key. At this time, the radiotelephone will no longer function automatically in the radiotelephone system. Table 3 shows the test commands and the corresponding results.

#### NOTE

The radiotelephone must be in the status display self-test level (J7-pin 11 or J5-pin 21 grounded prior to radio power up) in order to enable the servicing level self-test mode.

### 5.2.3 NAM Contents

The contents of the NAM (number assignment module) are displayed in the servicing level of the self-test mode for models equipped with a display. Table 6 defines all the NAM contents and is used with Table 7 to interpret certain

hexadecimal values when programming for earlier version mobile telephones. For programming the NAM in later version mobile telephones refer to instruction manual 68P81116E77. To distinguish between earlier/later version mobile telephones refer to paragraph **1.8 NAM Programming** of this instruction manual.



Table 5. Test Commands For Self-Test Mode

NOTES

1. Each command consists of at least two digits entered from the handset keypad with the entry terminated using the (#) key.

2. If the command relates to a test function with multiple data displays, the (\*) key is used to pause at scanning data or to step through sequential test functions. Entering the (\*) key during a pause time resumes scanning.

3. For commands that initiate an action that requires a response or that accumulates error counts, the (#) key terminates the test.

4. “(ND)” in the keypad entry column indicates tests that provide a valid, usable diagnostic function for models not provided with a display. These tests also apply, of course, to those models with displays.

Keypad Entry	Command Description	Status Display	Result			
#	Enter Test Command Mode					
01#(ND)	Restart (Re-enter dc power start-up routine)					
02#	Radio Status Request	AAA BBB CDEFGHI	AAA = Channel Number (decimal) BBB = RSSI reading for channel C = SAT Frequency 0 = 5970 Hz 1 = 6000 Hz 2 = 6030 Hz 3 = No Lock D = Carrier (1 = ON) E = Signaling Tone (1 = ON) F = Power Attenuation Level (0, 1, ...7) G = Mode (1 = control channel, 0 = voice channel) H = Receive Audio Mute (1 = muted) I = Transmit Audio Mute (1 = muted)			
03#(ND)	Reset Autonomous Timer		This command results in the reset of the autonomous timer but does not provide any test function on these models.			
04#(ND)	Initialize Transceiver		Carrier = OFF Atten. = 0 dB Receive Audio = MUTED Transmit Audio = MUTED Signaling Tone = OFF Auto. timer RESET and periodic resetting ENABLED SAT = OFF DTMF & Audio Tones = OFF Audio Path = TO SPEAKER			
05#(ND)	Carrier On		Turn carrier on			
06#(ND)	Carrier Off		Turn carrier off			
07#(ND)	Rx Mute		Mute the receive audio			
08#(ND)	Rx Unmute		Unmute the receive audio			
09#(ND)	Tx Mute		Mute the transmit audio			
10#(ND)	Tx Unmute		Unmute the transmit audio			
11ABC#(ND)	Load Synth		Load synthesizer with ABC where ABC = channel number in decimal			
12A#(ND)	Set ATTN	(High)	Set rf power attenuation to A where A = attenuation level (0, 1.....7) The following table shows the attenuation levels vs the TTL levels found on the AOC control lines on the audio/logic board.			
			Attenuation Level	AOC0 (U2-pin 8)	AOC1 (U2-pin 9)	AOC2 (U2-pin 10)
			0	0	0	0
			1	1	0	0
			2	0	1	0
			3	1	1	0
			4	0	0	1
			5	1	0	1
		(Low)	6	0	1	1
			7	1	1	1
13#(ND)	RESETOFF		This command should result in power-down of the mobile			
14#(ND)	STON		Transmit signaling tone			
15#(ND)	STOFF		Stop transmitting signaling tone			

Table 5. Test Commands For Self-Test Mode (Cont'd.)

Keypad Entry	Command Description	Status Display	Result														
16#(ND)	SETUP		Transmit a five word reverse control channel message; each of the five words will be "FF00AA55CC33".														
17#(ND)	VOICE		Transmit a two word reverse voice channel message; both words will be "FF00AA55CC33".														
18#	SEND NAM	AA BB	AA = Address, BB = Data Displays the contents of the NAM, one address at a time, advanced by depressing the (*) key. The following data is contained in NAM, refer to Table 6 for a detailed explanation. The test is exited by depressing the (#) key. <table><tr><td>SIDH</td><td>Security Code</td></tr><tr><td>Options (1, 2, &amp; 3)</td><td>Decimal MIN</td></tr><tr><td>MIN1, MIN2</td><td>FCHNA</td></tr><tr><td>SCM</td><td>FCHNB</td></tr><tr><td>IPCH</td><td>NDED</td></tr><tr><td>ACCOLC</td><td>CHECKSUM</td></tr><tr><td>GIM</td><td></td></tr></table>	SIDH	Security Code	Options (1, 2, & 3)	Decimal MIN	MIN1, MIN2	FCHNA	SCM	FCHNB	IPCH	NDED	ACCOLC	CHECKSUM	GIM	
SIDH	Security Code																
Options (1, 2, & 3)	Decimal MIN																
MIN1, MIN2	FCHNA																
SCM	FCHNB																
IPCH	NDED																
ACCOLC	CHECKSUM																
GIM																	
19#	VERSION		Display software version number														
<b>NOTE</b> Entering commands 20# through 23# or 27# causes the transceiver to begin a counting sequence or continuous transmission as described below. In order to exit from the commands to enter another test command, the (#) key must be depressed; all other key depressions are ineffectual.																	
20#	RCVS 1		Receive control channel messages counting correctable and uncorrectable errors. When the command starts, the number of the command will be displayed in the upper right hand corner of the display. Entering a # key will terminate the command and display two three-digit numbers in the display. The first number is the number of correctable errors and the second is the uncorrectable errors.														
21#	RCVV 1		Receive voice channel messages counting correctable and uncorrectable errors. When the command starts, the number of the command will be displayed in the upper right hand corner of the display. Entering a # key terminates the command and will display two three-digit numbers in the display. The first is the number of correctable errors and the second is the uncorrectable errors.														
22#	WSTS		Receive control channel messages counting word sync sequence. When the command starts, the number of the command will be displayed in the upper right hand corner of the display. Entering a # key will terminate the command and display the number of word sync sequences in the display.														
23#	WSTV		Receive voice channel messages counting word sync sequences. When the command starts, the number of the command will be displayed in the upper right hand corner of the display. Entering a # key will terminate the command and display the number of word sync sequences in the display.														
24#	BIBIT		Receive control channel data and display the majority voted busy/idle bit. 0 = idle 1 = busy														
25# (ND)	SATON		Enable the transmission of SAT														
26# (ND)	SATOFF		Disable the transmission of SAT														
27# (ND)	CDATA		Transmit continuous control channel data. All words will be the same as the "SETUP" command. When the command starts the number of the command will be displayed in the upper right hand corner of the display. Entering a # key will terminate the command.														
28# (ND)	HITNON		Activate the high tone (1150 Hz $\pm$ 55 Hz)														
29# (ND)	HITNOFF		De-activate the high tone														
30# (ND)	LOTNON		Activate the low tone (770 Hz $\pm$ 40 Hz)														
31# (ND)	LOTNOFF		De-activate the low tone														
32# (ND)	INVM		Initialize non-volatile memory to all zeros. This command should be reserved for special situations where reprogramming will be required (such as memory chip or circuit board replacement or when a mobile is to be reissued to a new subscriber).														
33A# (ND)	DTMFON		Activate DTMF tone (A = DTMF digit, 0 through 9)														
34# (ND)	DTMFOFF		De-activate DTMF tone														



Table 5. Test Commands For Self-Test Mode (Cont'd.)

Keypad Entry	Command Description	Status Display	Result																										
35A# (ND)	PATH		Change the audio path to A, where A =: 0 = Handsfree 1 = Speaker 2 = Alert 3 = Handset																										
36ABC#	SCAN	AAA BBB	Activate channel scan (ABC = Scan speed in milliseconds). Tunes successfully from channel 1 to 666. Entering (*) pauses the scan and displays current Channel Number and RSSI reading (AAA = Channel Number and BBB = RSSI Reading). When Scan Speed is 300 milliseconds or greater, the current status is displayed during the scan; when less than 300 milliseconds the status is displayed only during pause. Entering (*) during a pause causes the scan to resume. Entering (#) aborts the scan and leaves the mobile tuned to the current channel. During this command only the (*) and (#) keys are recognized.																										
37#	NOT ASSIGNED																												
38#	SND-SNM	AA BB	AA = Address; BB = Data Send the SNM to the display. All 32 bytes of the SNM will be displayed, one byte at a time. The byte address will be displayed in the upper right hand corner and the contents of that address will be displayed in hex. The (*) key is used to step through the addresses similar to the SEND-NAM command.																										
39#	RCVSU		Receive one control channel word. When the word is received it is displayed in hex. This command will be complete when a control channel word is received or when the (#) key is entered to abort the command.																										
40#	RCVVC		Receive one voice channel word. When the word is received it is displayed in hex. This command will be complete when a voice channel word is received or when the (#) key is entered to abort the command.																										
41# (ND)	ENDIV		Enables the diversity option. On mobiles equipped with receive diversity hardware and marked for diversity [NAM OPTIONS (3)], tests can be made to check for diversity switching.																										
42# (ND)	DISDIV		Disables the diversity option.																										
43# (ND)	TRANT		Disables the diversity function and causes mobile to use T/R antenna.																										
44# (ND)	RANT		Disables the diversity function and causes mobile to use Rx antenna.																										
45#	READ RSSI		Returns the RSSI reading taken on the current channel. The number is displayed as a three digit decimal number. <b>RSSI Circuitry Testing Procedure</b> 1. Enter command 11 ABC# where ABC represents decimal channel number (333 recommended).  2. Set rf signal generator for appropriate frequency (879.990 MHz for channel 333).  3. Set rf generator level at -105 dBm.  4. Inject RF signal at antenna and vary the amplitude to produce the voltages in column 1 below at connector J7-pin 4. The corresponding RSSI reading (column 2) should be displayed. <table><tr><th>RSSI DC Voltage (J7-pin 4)</th><th>RSSI Reading (Control Unit 3-digit display)</th></tr><tr><td>.25</td><td>007-012</td></tr><tr><td>.50</td><td>014-019</td></tr><tr><td>.75</td><td>022-027</td></tr><tr><td>1.00</td><td>029-034</td></tr><tr><td>1.25</td><td>036-041</td></tr><tr><td>1.50</td><td>043-048</td></tr><tr><td>1.75</td><td>050-055</td></tr><tr><td>2.00</td><td>057-062</td></tr><tr><td>2.25</td><td>065-070</td></tr><tr><td>2.50</td><td>072-077</td></tr><tr><td>2.75</td><td>079-084</td></tr><tr><td>3.00</td><td>086-091</td></tr></table>	RSSI DC Voltage (J7-pin 4)	RSSI Reading (Control Unit 3-digit display)	.25	007-012	.50	014-019	.75	022-027	1.00	029-034	1.25	036-041	1.50	043-048	1.75	050-055	2.00	057-062	2.25	065-070	2.50	072-077	2.75	079-084	3.00	086-091
RSSI DC Voltage (J7-pin 4)	RSSI Reading (Control Unit 3-digit display)																												
.25	007-012																												
.50	014-019																												
.75	022-027																												
1.00	029-034																												
1.25	036-041																												
1.50	043-048																												
1.75	050-055																												
2.00	057-062																												
2.25	065-070																												
2.50	072-077																												
2.75	079-084																												
3.00	086-091																												
46#	Recall Timer		Displays cumulative call time from counter in non-volatile memory.																										

Table 5. Test Commands For Self-Test Mode (Cont'd.)

Keypad Entry	Command Description	Status Display	Result																																																																																	
47A# (ND)	AUDLEV		Set audio level where A = level (0 = lowest, 6 = highest, or 7 = muted) The following table shows the attenuation steps, the amount of gain or attenuation, and the logic levels found on the Rx audio volume control lines on the audio/logic board.																																																																																	
			<b>Volume Level Step</b>	<b>Gain or Attenuation</b>	<b>AUDIO 0 (U2-Pin 4)</b>	<b>AUDIO 1 (U2-Pin 5)</b>	<b>AUDIO 2 (U2-Pin 7)</b>																																																																													
			6	+ 10 dB	1	1	0																																																																													
			5	+ 5 dB	1	0	1																																																																													
			4	0 dB	1	0	0																																																																													
			3	-5 dB	0	1	1																																																																													
			2	-10 dB	0	1	0																																																																													
			1	-15 dB	0	0	1																																																																													
			0	-20 dB	0	0	0																																																																													
7 (Mute)	-40 dB	1	1	1																																																																																
48# (ND)	SIDETONE ON		Enable sidetone.																																																																																	
49# (ND)	SIDETONE OFF		Disable sidetone.																																																																																	
50#	MAINN		Maintenance data is transmitted and test results displayed: PASS = received data is correct FAIL 1 = 2-second timeout, no data received FAIL 2 = received data is incorrect																																																																																	
51#	MAINL		Test of mobile where maintenance data is transmitted and looped back. Display is as follows: PASS = looped-back data is correct FAIL 1 = 2-second timeout, no looped-back data FAIL 2 = looped-back data is incorrect																																																																																	
52A# (ND)	SAT PHASE ADJ		A = decimal value that corresponds to phase shift compensation in 4.5° increments. Compensation added to inherent phase shift in transceiver to achieve a total of zero degrees phase shift. DO NOT ENTER ANY VALUES EXCEPT THOSE SHOWN.  <table><tr><td>0° = 0</td><td>121.5° = 59</td><td>243.0° = 86</td></tr><tr><td>4.5° = 1</td><td>126.0° = 60</td><td>247.5° = 87</td></tr><tr><td>9.0° = 2</td><td>130.5° = 61</td><td>252.0° = 112</td></tr><tr><td>13.5° = 3</td><td>135.0° = 62</td><td>256.5° = 113</td></tr><tr><td>18.0° = 4</td><td>139.5° = 63</td><td>261.0° = 114</td></tr><tr><td>22.5° = 5</td><td>144.0° = 40</td><td>265.5° = 115</td></tr><tr><td>27.0° = 6</td><td>148.5° = 41</td><td>270.0° = 116</td></tr><tr><td>31.5° = 7</td><td>153.0° = 42</td><td>274.5° = 117</td></tr><tr><td>36.0° = 16</td><td>157.5° = 43</td><td>279.0° = 118</td></tr><tr><td>40.5° = 17</td><td>162.0° = 44</td><td>283.5° = 119</td></tr><tr><td>45.0° = 18</td><td>166.5° = 45</td><td>288.0° = 120</td></tr><tr><td>49.5° = 19</td><td>171.0° = 46</td><td>292.5° = 121</td></tr><tr><td>54.0° = 20</td><td>175.5° = 47</td><td>297.0° = 122</td></tr><tr><td>58.5° = 21</td><td>180.0° = 64</td><td>301.5° = 123</td></tr><tr><td>63.0° = 22</td><td>184.5° = 65</td><td>306.0° = 124</td></tr><tr><td>67.5° = 23</td><td>189.0° = 66</td><td>310.5° = 125</td></tr><tr><td>72.0° = 48</td><td>193.5° = 67</td><td>315.0° = 126</td></tr><tr><td>76.5° = 49</td><td>198.0° = 68</td><td>319.5° = 127</td></tr><tr><td>81.0° = 50</td><td>202.5° = 69</td><td>324.0° = 104</td></tr><tr><td>85.5° = 51</td><td>207.0° = 70</td><td>328.5° = 105</td></tr><tr><td>90.0° = 52</td><td>211.5° = 71</td><td>333.0° = 106</td></tr><tr><td>94.5° = 53</td><td>216.0° = 80</td><td>337.5° = 107</td></tr><tr><td>99.0° = 54</td><td>220.5° = 81</td><td>342.0° = 108</td></tr><tr><td>103.5° = 55</td><td>225.0° = 82</td><td>346.5° = 109</td></tr><tr><td>108.0° = 56</td><td>229.5° = 83</td><td>351.0° = 110</td></tr><tr><td>112.5° = 57</td><td>234.0° = 84</td><td>355.5° = 111</td></tr><tr><td>117.0° = 58</td><td>238.5° = 85</td><td>360.0° = 70</td></tr></table>	0° = 0	121.5° = 59	243.0° = 86	4.5° = 1	126.0° = 60	247.5° = 87	9.0° = 2	130.5° = 61	252.0° = 112	13.5° = 3	135.0° = 62	256.5° = 113	18.0° = 4	139.5° = 63	261.0° = 114	22.5° = 5	144.0° = 40	265.5° = 115	27.0° = 6	148.5° = 41	270.0° = 116	31.5° = 7	153.0° = 42	274.5° = 117	36.0° = 16	157.5° = 43	279.0° = 118	40.5° = 17	162.0° = 44	283.5° = 119	45.0° = 18	166.5° = 45	288.0° = 120	49.5° = 19	171.0° = 46	292.5° = 121	54.0° = 20	175.5° = 47	297.0° = 122	58.5° = 21	180.0° = 64	301.5° = 123	63.0° = 22	184.5° = 65	306.0° = 124	67.5° = 23	189.0° = 66	310.5° = 125	72.0° = 48	193.5° = 67	315.0° = 126	76.5° = 49	198.0° = 68	319.5° = 127	81.0° = 50	202.5° = 69	324.0° = 104	85.5° = 51	207.0° = 70	328.5° = 105	90.0° = 52	211.5° = 71	333.0° = 106	94.5° = 53	216.0° = 80	337.5° = 107	99.0° = 54	220.5° = 81	342.0° = 108	103.5° = 55	225.0° = 82	346.5° = 109	108.0° = 56	229.5° = 83	351.0° = 110	112.5° = 57	234.0° = 84	355.5° = 111	117.0° = 58	238.5° = 85	360.0° = 70
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*Table 6. Description of NAM Contents*

<p>Each NAM contents display consists of a 2-digit hexadecimal address and two digits of hexadecimal data. The explanation below is used in conjunction with Table 7. The following conventions are used to represent the hexadecimal data in the left margin for each function stored in NAM. A "0" is used to for unused locations, an "x" is used for data that is part of the previous or succeeding function, capital letters are used for correspondence with the DECIMAL VALUES columns in Table 7, lowercase letters are used when the BINARY NUMBER column is to be used, and Arabic numerals are used when decimal values are stored.</p>	
<b>SIDH (System ID-Hexadecimal)</b> 00 DC 01 BA	<p>To convert the SIDH displayed for addresses 00 and 01 to its decimal equivalent, use Table 7. Locate each displayed value in the HEX DIGIT column and note the decimal values in corresponding columns D, C, B, and A. The sum of the four values is the decimal SID.</p> <p>For: 00 4A                  01 35</p> <p><math>16,384 + 2,560 + 48 + 5 = 18,997</math></p>
<b>OPTIONS (1)</b> 02 ba	<p>The option code displayed for address 02 represents the status of eight options. To interpret the option status refer to Table 7 and translate the displayed values in the HEX DIGIT column to the BINARY NUMBER. The binary number for the first HEX digit followed by the one for the second form an 8-position map for the eight options, b7 through b0, left to right.</p> <p>For: 02 6E</p> <p>b7 = 0                      Local Use. If set to 1, mobile would respond to local control orders in the home area or when the group ID is matched.</p> <p>b6 = 1                      Preferred System. Indicates preferred system A. If set to 0, preferred system B would be selected.</p> <p>b5 = 1                      End-to-End Signaling. Indicates mobile is equipped for DTMF signaling and can signal after connection is made.</p> <p>b4 = 0                      Test Mobile. If set to 1 mobile would be marked as a Motorola specially-configured test mobile.</p> <p>b3 = 1                      Repertory. Indicates mobile equipped with speed-dialing storage.</p> <p>b2 = 1                      Auxiliary Alert. Indicates mobile equipped for auxiliary incoming-call signaling.</p> <p>b1 = 1                      H/F-Automute. Indicates Auto-Mute function will be performed for placing an on-hook call.</p> <p>b0 = 0                      MIN Mark. Indicates mobile does not use area code when originating or answering a call unless requested by the base site equipment. If set to a 1, the area code is always included. This application is determined by the local carrier's system configuration.</p>
<b>MIN2 (Mobile Identification Number 2 — area code)</b> 03 CB 04 A0	<p>To convert the MIN2 (area code) displayed for addresses 03 and 04 to the decimal equivalent, use Table 7 and proceed as follows.</p> <ol style="list-style-type: none"> <li>1. Locate each displayed digit in the HEX DIGIT column and note the decimal value in corresponding columns C, B, and A.</li> <li>2. Add the three decimal numbers.           <p>(Ex. 1) For: 03 0C                          04 90</p> <p><math>0 + 192 + 9 = 201</math></p> <p>(Ex. 2) For: 03 1E                          04 A0</p> <p><math>256 + 224 + 10 = 490</math></p> </li> <li>3. Increase the value of each digit by 1. "9" increased by 1 equals "0". The result is the decimal area code.           <p>(Ex. 1) <math>201 = 312</math>                  (Ex. 2) <math>490 = 501</math></p> </li> </ol>

*Table 7. Description of NAM Contents (Cont'd.)*

<b>SCM (Station Class Mark)</b> 05 ax	The station class mark shown in the first digit for address 05 can have a value from 0 to F and indicates the power class and type of cellular telephone equipment. For mobile equipment, the SCM is normally 0.
<b>MIN1 (Mobile Identification Number 1 — exchange code and number)</b> 05 xf 06 ed 07 cb 08 a0	<p>For MIN1 the 3-digit exchange number is encoded, the thousands digit of the number is stored without encoding (a “0” is stored as an “A”), and the last three digits are encoded. To convert MIN1 displays to the decimal exchange and number, use Table 7 and proceed as follows.</p> <ol style="list-style-type: none"><li>1. Locate each displayed value (f, e, d, c, b, a) in the HEX DIGIT column and note the BINARY NUMBER.  For: 05 x4 06 78 07 7E 08 70  0100 0111 1000 0111 1110 0111</li><li>2. Regroup the six binary numbers into seven groups of 2, 4, 4, 4, 2, 4, and 4 bits, labeling the groups C, B, A, A, C, B, A.  For the example:  01    0001    1110    0001    11    1110    0111 C    B    A    A    C    B    A</li><li>3. Locate each BINARY NUMBER in the first column and note the decimal values in corresponding C, B, and A columns.</li><li>4. Add the first three numbers to each other, record the fourth number, and add the last three numbers to each other.  For the example:  256 + 16 + 14 = 286 1 768 + 224 + 7 = 999</li><li>5. Increase the value of each digit of the 3-digit numbers by 1. “9” increased by 1 equals “0”. The resultant 3-digit number, single digit, 3-digit number is the exchange code and telephone number.  For the example:  286 = 397 1 = 1            397-1000 999 = 000</li></ol>
<b>IPCH (Initial Paging Channel)</b> 09 0C 0A BA	<p>This specifies which channel to start the paging scan. The initial channel is dependent upon the system design of the particular home area carrier. To determine the designated channel from the display, use Table 7 and proceed as follows.</p> <ol style="list-style-type: none"><li>1. Locate each displayed digit in the HEX DIGIT column and note the decimal value in corresponding columns C, B, and A.</li><li>2. Add the three decimal numbers.  For: 09 01 0A 4E  256 + 64 + 14 = 334</li></ol>
<b>ACCOLC (Access Overload Class)</b> 0B 0A	This number (from 0 to F) specifies the level of priority assigned to the mobile for accessing the system. These numbers are defined by the local carrier and there is not necessarily a relationship between numbers and priority [that is higher (or lower) numbers do not mean higher priority].
<b>GIM (Group Identification Mark)</b> 0C 0A	This number (from 0 to F) specified how many of the most significant bits the 15-bit System ID are compared during call processing. This number is determined by the local carrier.
<b>Security Code (6-Digit)</b> 0D 12 0E 34 0F 56	Addresses 0D, 0E and 0F store the code used by the subscriber to check and change the 3-digit lock code and service levels. The displayed numbers indicate the security code with “0” represented by an “A”.



Table 6. Description of NAM Contents (Cont'd.)

<b>DMIN (Decimal Mobile Identification Number)</b> 10 31 11 25 12 55 13 12 14 34	These addresses display the mobile identification number in decimal with "0" represented by an "A".
<b>FCHNA (Forward Channel A)</b> 15 0C 16 BA	This specifies which channel, in the system designated by the preferred system mark, to start the initialization scan. In North America, the initial channel for preferred system A is 333. To determine the designated channel refer to the procedures provided for the IPCH (Initial Paging Channel) addresses.
<b>FCHNB (Forward Channel B)</b> 17 0C 18 BA	This specifies which channel, in the system designated by the preferred system mark, to start the initialization scan. In North America, the initial channel for the preferred system B is 334. To determine the designated channel refer to the procedures provided for the IPCH (Initial Paging Channel) addresses.
<b>NDED (Number of Dedicated Channels)</b> 19 BA	<p>The number in the display for address 19 represents the number of dedicated forward control channels (FOCC) in the system. In North America, the number of channels is 21. To interpret the number in the display use Table 7 and proceed as follows.</p> <ol style="list-style-type: none"> <li>1. Locate each displayed digit in the HEX DIGIT column and note the decimal value in corresponding columns B and A.</li> <li>2. Add the two decimal numbers.</li> <li>3. The number of channels is one more than the number obtained in Step 2.</li> </ol> <p>For: 19 14</p> $16 + 4 = 20 \qquad 20 + 1 = 21$
<b>NOT ASSIGNED</b> 1A 00 1B 00	
<b>OPTIONS (3)</b> 1C 0a	<p>The option code displayed for address 1C represents the status of two options with b1 and b0. Refer to Options (2).</p> <p>b0 = 0                      Diversity. If set to 1 the mobile should be equipped with receive diversity hardware.</p> <p>b1 = 0                      Permits subscriber to select between operation in system A or in system B. If set to 1, the mobile would perform automatic system selection.</p>
<b>OPTIONS (2)</b> 1D ba	<p>The option code displayed for address 1D represents the status of eight options. To interpret the option status refer to Table 7 and translate the displayed values in the HEX DIGIT column to the BINARY NUMBER. The binary number for the first HEX digit followed by the one for the second form an 8-position map for the eight options, b7 through b0, left to right.</p> <p>For: 1D 00</p> <p>b7 = 0                      Reserved Option</p> <p>b6 = 0                      Defines the number of digits in the repertory feature at 14. If set to 1, 24 digits would be provided.</p> <p>b5 = 0                      Timer Enable. If set to 1 cumulative call time would be stored in memory (rental car applications).</p> <p>b4 = 0                      Extended Field. If set to 1 mobile would expect more than 32 paging channels.</p> <p>b3 = 0                      Single System Scan. If set to 1, the mobile would be scan only one system based on the preferred system bit (OPTIONS 1).</p> <p>b2 = 0                      Auto Recall. If set to 1, the mobile would recognize a valid 2-digit-SND sequence as repertory dialing.</p> <p>b1 = 0                      Disable Service Level. If set to 1, service levels could not be changed from the control unit.</p> <p>b0 = 0                      Disable Lock. If set to 1 the lock feature would be disabled.</p>

Table 6. Description of NAM Contents (Cont'd.)

<b>CHECKSUM</b>	These locations contain values that are used in automatic selftests that check the integrity of the NAM contents.
1E xx	
1F xx	

Table 7. Binary-Hex-Decimal Conversion

Binary Number	HEX Digit	Decimal Values			
		D	C	B	A
0000	0	0	0	0	0
0001	1	4,096	256	16	1
0010	2	8,192	512	32	2
0011	3	12,288	768	48	3
0100	4	16,384	1,024	64	4
0101	5	20,480	1,280	80	5
0110	6	24,576	1,536	96	6
0111	7	28,672	1,792	112	7
1000	8	—	2,048	128	8
1001	9	—	2,304	144	9
1010	A	—	2,560	160	10
1011	B	—	2,816	176	11
1100	C	—	3,072	192	12
1101	D	—	3,328	208	13
1110	E	—	3,584	224	14
1111	F	—	3,840	240	15









